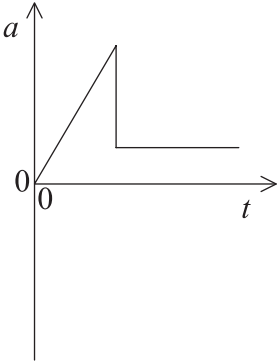
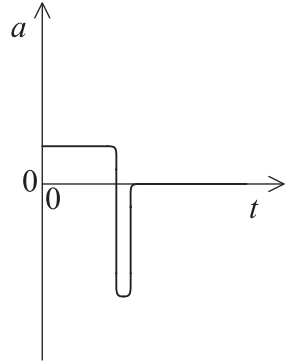
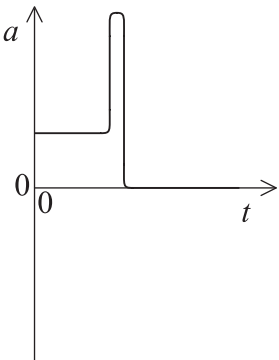
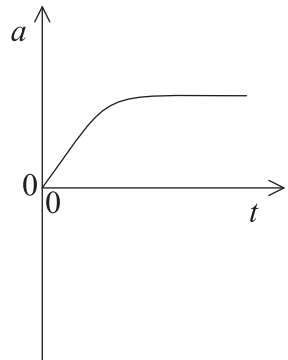
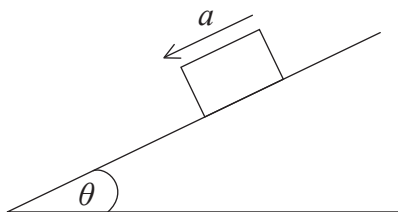


1. A cube has sides of length  $10(\pm 1)$  mm. What is the percentage uncertainty in the volume of the cube?
  - A. 1 %
  - B. 3 %
  - C. 10 %
  - D. 30 %
  
2. A toy car accelerates from rest down an inclined track at  $2.0 \text{ ms}^{-2}$ . What is the speed of the car after 3.0 s?
  - A.  $6.0 \text{ ms}^{-1}$
  - B.  $9.0 \text{ ms}^{-1}$
  - C.  $45 \text{ ms}^{-1}$
  - D.  $54 \text{ ms}^{-1}$
  
3. A parachutist jumps out of an aircraft and falls freely for a short time, before opening his parachute. Which graph shows the variation of the acceleration  $a$  with time  $t$  of the parachutist from the time he leaves the aircraft until after the parachute is completely open?
  - A. 
  - B. 
  - C. 
  - D. 

4. An object of mass  $m$  slides with acceleration  $a$  down a plane which makes an angle  $\theta$  with the horizontal.



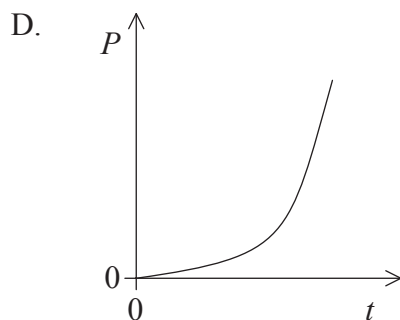
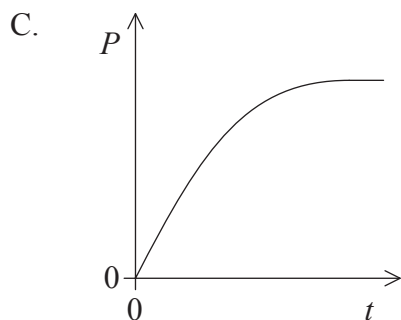
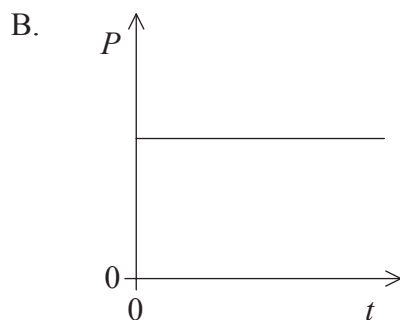
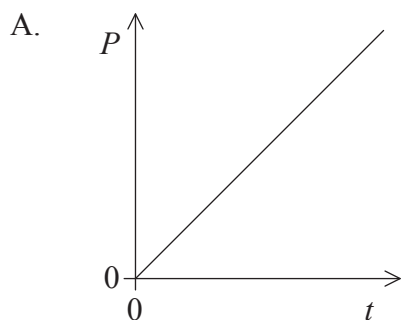
The acceleration of free-fall is  $g$ . What is the frictional force between the object and the plane?

- A.  $m(g - a)$
  - B.  $m(a \sin \theta + g)$
  - C.  $m(g \sin \theta + a)$
  - D.  $m(g \sin \theta - a)$
5. A mass hangs freely from the end of a spring. A student raises the mass vertically until the tension in the spring becomes zero. The gain in gravitational potential energy of the mass is equal to the work done
- A. by the student against the force of gravity acting on the mass.
  - B. on the mass by the student plus the elastic potential energy lost by the spring.
  - C. on the mass by the student minus the elastic potential energy lost by the spring.
  - D. on the mass by the student minus the work done on the mass by the tension in the spring.

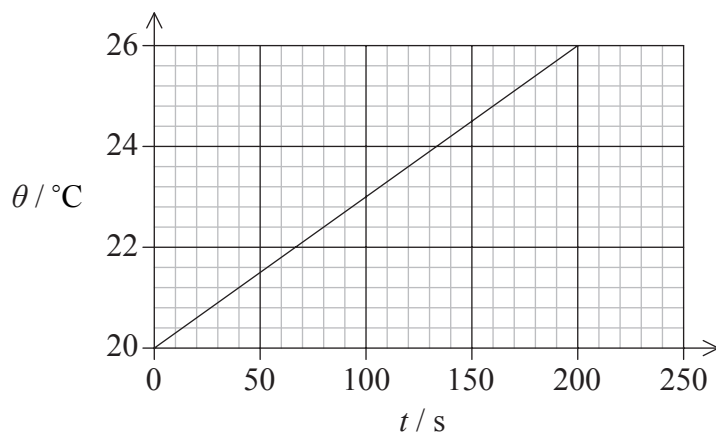
6. An object of mass  $m$  moving with velocity  $u$  collides with and sticks to an identical stationary object. Immediately after the collision the combined object moves with velocity  $v$ . What will be the loss of kinetic energy?

- A.  $\frac{1}{4}mu^2$
- B.  $\frac{1}{4}mv^2$
- C.  $\frac{1}{2}mv^2$
- D.  $\frac{1}{4}m(v-u)^2$

7. A car is driven along a straight horizontal track. The car's engine produces a constant driving force. The car starts from rest and the effects of friction and air resistance are negligible. Which graph represents the variation with time  $t$  of the power  $P$  developed by the engine?



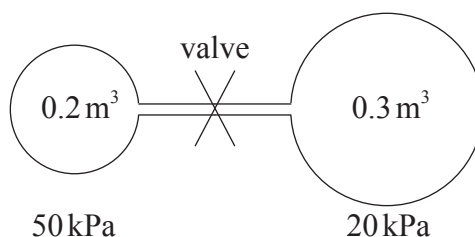
8. An electrical heater of power 12 W is immersed in a liquid of mass 0.2 kg. The graph shows the variation of the temperature  $\theta$  of the liquid with time  $t$ .



What is the value for the specific heat capacity of the liquid?

- A.  $20 \text{ J kg}^{-1} \text{ K}^{-1}$
- B.  $500 \text{ J kg}^{-1} \text{ K}^{-1}$
- C.  $2000 \text{ J kg}^{-1} \text{ K}^{-1}$
- D.  $12\,000 \text{ J kg}^{-1} \text{ K}^{-1}$
9. Why is wave-particle duality used in describing the properties of light?
- A. Light is both a wave and a particle.
- B. Both wave and particle models can explain all the properties of light.
- C. Different properties of light can be more clearly explained by using one of the wave or particle models.
- D. Scientists feel more confident when using more than one model to explain a phenomenon.

10. Two separate sealed containers hold air at the same temperature. They are connected by a thin tube containing a valve. Initially one container holds  $0.2\text{ m}^3$  of air at a pressure of  $50\text{ kPa}$  and the other container holds  $0.3\text{ m}^3$  of air at a pressure of  $20\text{ kPa}$ .



The valve is slowly opened and the temperature stays constant. What is the final pressure in the containers?

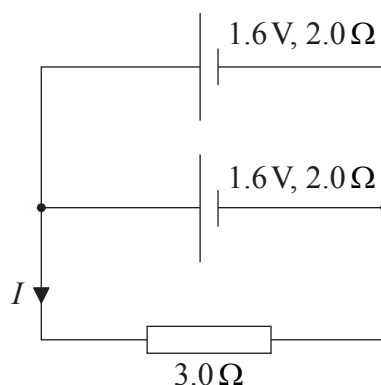
- A.  $32\text{ kPa}$
  - B.  $35\text{ kPa}$
  - C.  $38\text{ kPa}$
  - D.  $70\text{ kPa}$
11. In simple harmonic motion, the velocity leads the displacement by a phase angle  $\phi$ . What is the value of  $\phi$ ?
- A. Zero
  - B.  $\frac{\pi}{4}$
  - C.  $\frac{\pi}{2}$
  - D.  $\pi$

12. Which of the following, if any, will be transferred in the direction of propagation of a sound wave as it passes through the air?
- A. Mass only
  - B. Energy only
  - C. Both mass and energy
  - D. Neither mass nor energy
13. Some of the properties that can be demonstrated using waves are
- I. refraction
  - II. polarization
  - III. diffraction.

Which properties can be demonstrated using **sound** waves?

- A. I and II only
  - B. I and III only
  - C. II only
  - D. III only
14. A standing wave is produced by the superposition of two travelling waves. Which statement is **not** correct?
- A. The travelling waves must have the same frequency.
  - B. The travelling waves must have equal but opposite velocities.
  - C. In the standing wave, all the oscillating particles have the same amplitude.
  - D. In the standing wave, particles between adjacent nodes vibrate in phase.

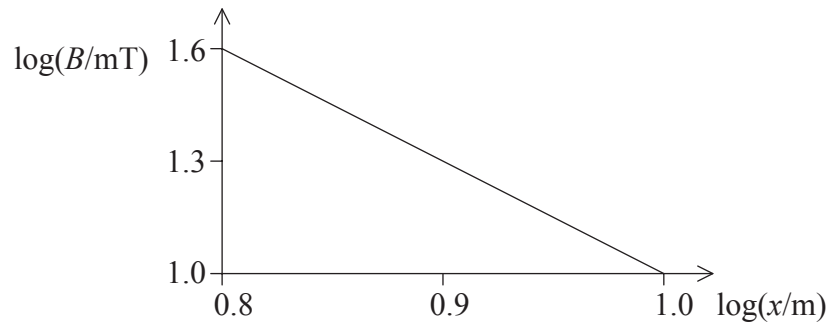
15. In a particular lightning flash a charge of 15 C flows in a time of 0.5 ms. What is the average current?
- A.  $33\ \mu\text{A}$
- B.  $7.5\ \text{mA}$
- C.  $30\ \text{A}$
- D.  $30\ \text{kA}$
16. A heating coil is connected to a battery of electromotive force (emf) 10 V and negligible internal resistance. The power dissipated in the coil is 25 W. What is the resistance of the coil?
- A.  $0.25\ \Omega$
- B.  $2.5\ \Omega$
- C.  $4.0\ \Omega$
- D.  $250\ \Omega$
17. Two identical cells, each of emf 1.6 V and internal resistance  $2.0\ \Omega$ , are connected in parallel with a  $3.0\ \Omega$  resistor.



What is the current  $I$ ?

- A.  $0.4\ \text{A}$
- B.  $0.6\ \text{A}$
- C.  $0.8\ \text{A}$
- D.  $1.6\ \text{A}$

18. The magnetic flux density  $B$  along the axis of a magnet is measured with distance  $x$  from the end of the magnet. The graph shows how  $\log B$  varies with  $\log x$ .



$B$  is proportional to which power of  $x$ ?

- A.  $-3$
  - B.  $-1.6$
  - C.  $1.6$
  - D.  $3$
19. An astronaut orbits the Earth in a space capsule. Which statement is correct?
- A. There are no gravitational forces acting on the space capsule or the astronaut.
  - B. The space capsule and the astronaut each have the same acceleration.
  - C. The space capsule and the astronaut are each in equilibrium.
  - D. The gravitational force on the space capsule is equal to that on the astronaut.



20. The table shows four of the energy levels for the hydrogen atom with their corresponding energies.

Energy level	Energy / $10^{-19}\text{J}$
6	–0.6
4	–1.4
2	–5.4
1	–21.8

When an electron changes from level 6 to level 1 the spectral line emitted has a wavelength of  $9.4 \times 10^{-8}\text{m}$ . What is the approximate wavelength of the spectral line emitted when an electron changes from level 4 to level 2?

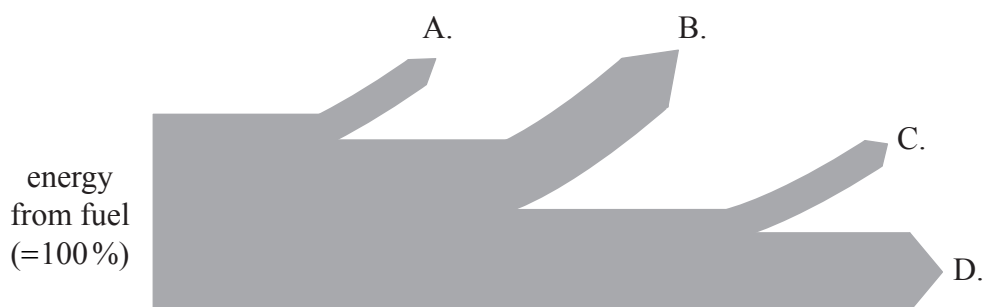
- A.  $5 \times 10^{-4}\text{m}$
  - B.  $5 \times 10^{-7}\text{m}$
  - C.  $5 \times 10^{-8}\text{m}$
  - D.  $5 \times 10^{-10}\text{m}$
21. The magnitude of the binding energy per nucleon is
- A. a maximum for nuclides having nucleon numbers around 60.
  - B. directly proportional to the neutron to proton ratio of nuclides.
  - C. a maximum for nuclides with high nuclear charges.
  - D. a maximum for nuclides with low nuclear charges.

22. A positive pion is a meson consisting of an up quark and an anti-down quark. A student suggests that the decay of the positive pion is represented by the following equation.

$$\pi^+ \rightarrow \mu^+ + \bar{\nu}_\mu$$

The suggestion is incorrect because one of the quantities is not conserved. Which quantity is **not** conserved in the student's equation?

- A. Charge
  - B. Baryon number
  - C. Lepton number
  - D. Strangeness
23. The Sankey diagram shows a typical fossil-fuel plant of total efficiency 40%. There are frictional, electrical transmission and energy losses to the lower temperature surroundings. Which branch represents energy losses to the surroundings?



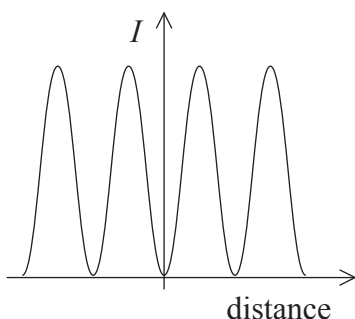
24. The absolute temperature of a black body increases by 2%. What is the percentage increase in the power emitted by the black body?
- A. 2
  - B. 4
  - C. 8
  - D. 16

25. What is thermal conduction mainly due to in a gas?

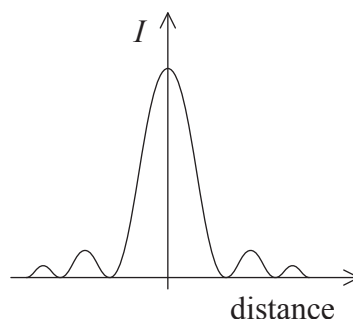
- A. The motion of free electrons
- B. Fast molecules transferring energy to slower molecules
- C. Slow molecules transferring energy to faster molecules
- D. Lattice vibrations causing collisions with neighbouring molecules

26. A single, narrow slit is illuminated by a parallel beam of monochromatic light and the image is projected onto a screen. Which graph shows how the intensity  $I$  of the diffracted light varies horizontally across the screen?

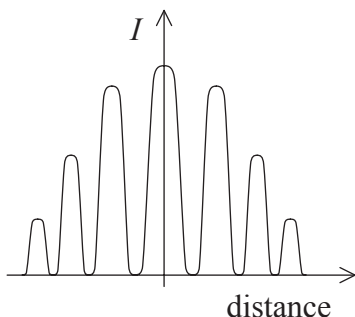
A.



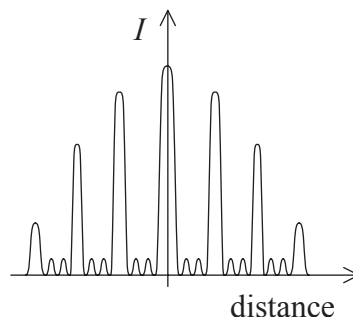
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C.



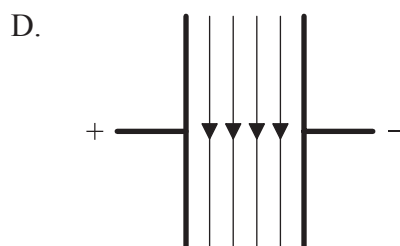
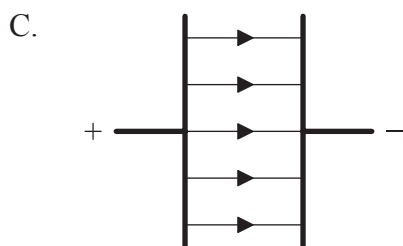
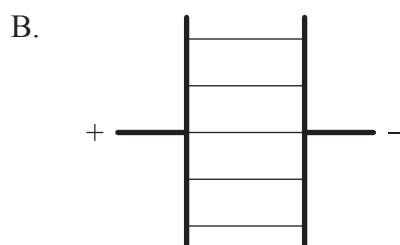
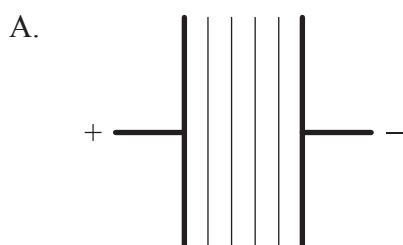
D.



27. In a double-slit experiment using monochromatic light, a fringe pattern is formed on screen. A decrease in which of the following will increase the separation of the fringes?

- A. Wavelength of the light
- B. Distance between the slits and the screen
- C. Separation of the slits
- D. Intensity of the light source

28. In a particular optical microscope, which colour of light is likely to produce the best resolution in the final image?
- A. Yellow
- B. Red
- C. Green
- D. Blue
29. A source emits sound of frequency 500 Hz. The source approaches a stationary observer at  $30 \text{ m s}^{-1}$ . The speed of sound is  $330 \text{ m s}^{-1}$ . What is the frequency of the sound detected by the observer?
- A. 460 Hz
- B. 500 Hz
- C. 530 Hz
- D. 550 Hz
30. Which diagram shows the equipotential lines between a pair of parallel charged conductors?



31. What is the correct quantity and unit for electric potential?

	Quantity	Unit
A.	vector	$\text{Vm}^{-1}$
B.	vector	V
C.	scalar	$\text{Vm}^{-1}$
D.	scalar	V

32. The escape speed on a planet of mass  $M$  and radius  $r$  is  $v$ . What is the escape speed on a planet of mass  $2M$  and radius  $\frac{r}{2}$ ?

- A.  $\frac{v}{2}$
- B.  $v$
- C.  $2v$
- D.  $4v$

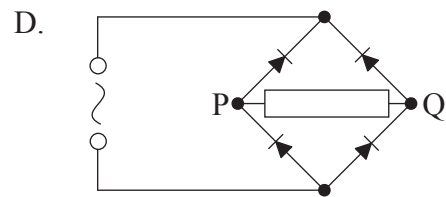
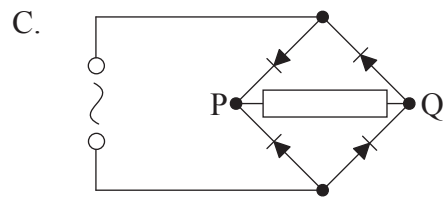
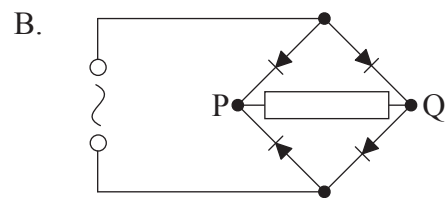
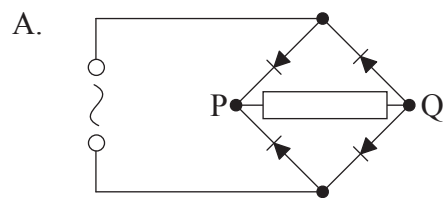
33. The gravitational field close to the surface of a planet is uniform. The gravitational potential difference between the surface of the planet and a point 30.0m above is  $15\text{Jkg}^{-1}$ . What is the work done in raising a mass of 4.0kg from the surface to a point 10.0m above the surface?

- A. 5J
- B. 10J
- C. 20J
- D. 80J

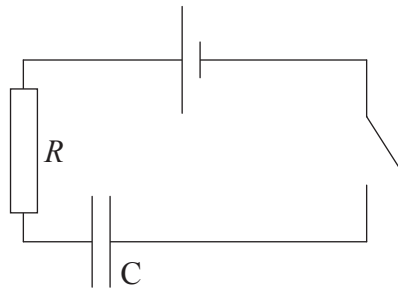
34. Lenz's law relates to electromagnetic induction. This law is a consequence of the conservation of which physical quantity?

- A. Momentum
- B. Energy
- C. Charge
- D. Current

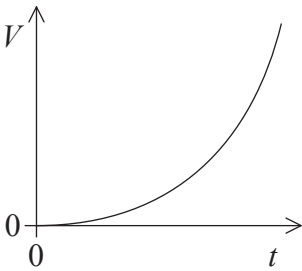
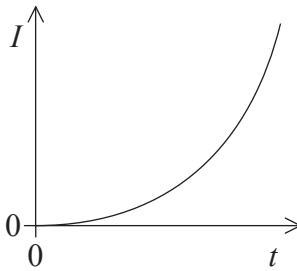
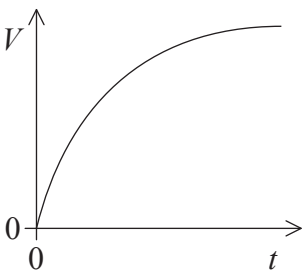
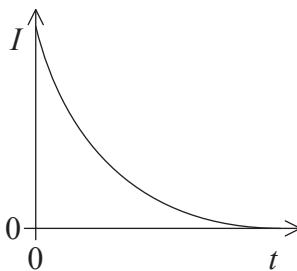
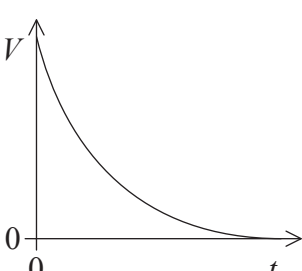
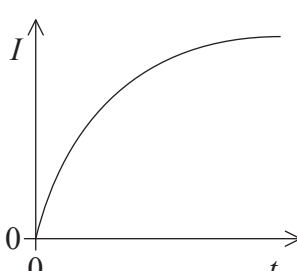
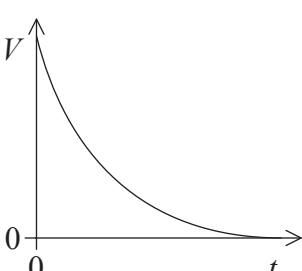
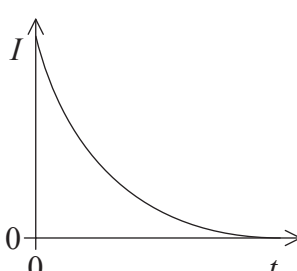
35. Which diode bridge is used to produce full-wave rectification of an alternating voltage so that P is positive and Q is negative?



36. The circuit shown is used to charge a capacitor  $C$  through a resistor  $R$ .



Which set of graphs correspond to the variation with time  $t$  of potential difference  $V$  across the capacitor and the current  $I$ , in the circuit, from the time that the switch is closed?

- A.  
- B.  
- C.  
- D.  

37. The work function of a metal is equal to the
- A. greatest energy with which an electron can be ejected from the surface by photoelectric emission.
  - B. least energy with which an electron can be ejected from the surface by photoelectric emission.
  - C. difference between the energy of a photon incident on the surface and the energy of the least energetic electron ejected.
  - D. difference between the energy of a photon incident on the surface and the energy of the most energetic electron ejected.
38. The density of the material in the nucleus of an atom
- A. is constant.
  - B. depends on the total number of nucleons in the nucleus.
  - C. depends only on the number of protons in the nucleus.
  - D. depends only on the number of neutrons in the nucleus.
39. A narrow beam of electrons passes through a thin crystalline film in an evacuated tube. A series of rings appears on a fluorescent screen at the end of the tube. What phenomenon within the film explains this observation?
- A. Emission of X-rays
  - B. Diffraction of electrons
  - C. Scattering of electrons
  - D. Ejection of neutrons
40. In radioactive  $\beta$  decay,  $\beta$  particles are emitted with a continuous spectrum of energies. This is because
- A. nuclei emitting  $\beta$  particles do not have discrete energy levels.
  - B. during a particular energy change, multiple  $\beta$  particles of differing energies are emitted.
  - C. during energy changes  $\beta$  particles share the energy with neutrinos.
  - D.  $\beta$  particle decay is always accompanied by the emission of  $\gamma$ -ray photons.
-